Hacienda Pública Española/Review of Public Economics

Manuscript 2292

Labour Supply Responses to Income Tax Changes in Spain

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Abstract.
This paper simulates the response of the Spanish labour supply to income tax changes using estimates for the intertemporal elasticity of substitution of leisure, calculated using a pseudo-panel built combining information from the EPA and the ECPF, for the period 1987-1997. According to our findings, income tax reforms have an impact on Spanish labour market, although the effects are quite small, making this mechanism a restricted tool for addressing the country's existing social security system deficit. Further, labour responses differ for men and women, across workers' age, as well as between permanent and fixed-term contract workers.

Keywords: Labour Supply; Labour Income Tax; Intertemporal Elasticity of Substitution of Leisure; Simulations.

JEL Codes: E62; H24; H31; J22.

***Acknowledgements:** This research has received financial support from the Spanish Agencia Estatal de Investigación and Fondo Europeo de Desarrollo Regional through project PID2021-124266OB-I00 (AEI/FEDER, UE); from Generalitat Valenciana (projects PROMETEU/2019/095 and PROMETEU/2020/83); and, from the Instituto de Estudios Fiscales, Spain. The authors thank the comments and suggestions of two anonymous referees, which have improved the final version of this paper. All remaining errors are ours.

1. Introduction.

The ageing of the population experienced by developed economies over the last 50 years, and the financial difficulties of the social security programs associated to that, have renewed interest in the relationship between income taxation and labour supply.[1] This work intends to investigate the ability of fiscal policy to alter labour supply in Spain through simulations of a life cycle model in which the intertemporal elasticity of substitution of leisure has been estimated with individual data.

Prescott (2004) was the first to address this topic, using OECD statistics to show that, contrary to what happened in the early 1970s, Americans worked more than Europeans, with tax rates being the most relevant factor. He simulates the tax rates using a standard neoclassical business cycle model (see Cooley, 1995) and compares the expected hours worked with actual hours worked. Prescott (2004) emphasised the significance of this finding for policy design, particularly policies aimed at financing social security, despite the fact that his findings were based on calibrated values of leisure preferences parameters that were inconsistent with previously available empirical evidence based on individual data. Following this research, Silva (2008) used the same model to confirm these findings for a small sample of nations, including Spain, and acknowledged the discrepancy with previous empirical results.

Prescott (2004) and Silva (2008) based their conclusions on a high implicit value for the elasticity of labour supply (about 2-3%) determined from calibrated values for the utility function parameters. Furthermore, their conclusions come from macro simulations

[1] The seminal reference on the issue of taxes and labour supply is Hausman (1985). Additionally, the interested reader may also see Meghir and Phillips (2010).

based on an equilibrium relation that is assimilable to the intratemporal first order condition of an intertemporal individual optimization model for consumption and leisure. In the present research (and simulations), we will employ the intertemporal first-order optimal condition of an intertemporal model and an estimated value for the elasticity of intertemporal substitution of leisure obtained with micro-level data, which differs from the previous analysis. Our calculated values for this elasticity are always less than 1, notably lower than the implicit values explored by Prescott (2004) and Silva (2008).[2]

In all of the scenarios examined, the responses in terms of the unemployment rate are consistently less than 1%. We simulate the response of leisure/labour supply for the complete sample of male (and female) wage earners and some of its subsamples, in particular for the categories of permanent and fixed-term contract workers, using these micro data calculated elasticities. The responses we get in equivalent terms of the unemployment rate are always below 1% in all of the cases analysed. Although there is evidence that female workers have higher substitution of leisure rates than males, we will apply the elasticities obtained in the male samples to the corresponding female samples in our simulations because it is difficult to obtain representative samples for households headed by women, during the sample period we study. Finally, while the results show that labour supply does respond to tax changes, the magnitude of the impacts suggest that this tax policy may not be enough to solve the social security financing challenge, given that the required increase in tax labour rates would be impossible to achieve.

The remainder of the paper is organised as follows: section two presents the theoretical model, and section three presents the empirical specification. The fourth section

[2] See Chetty et al. (2011), Chetty (2012), and Keane and Rogerson (2012) on the discrepancy in the values of the intertemporal elasticity of substitution of leisure using models with macro data *vs.* individual data.

presents the data and the methodology used to estimate wages for the various subsamples studied. The empirical findings are presented in part five, and the conclusion is presented in section six.

2. The theoretical model.

We provide a life-cycle model of intertemporal labour supply based on MaCurdy's work (1981 and 1983). According to this model, individuals choose leisure in each period to optimize their predicted life cycle utility function,

$$\underset{L_t}{\text{Max}}\, U = E_t \sum_{t=0}^{T-1} \beta^t\, u(L_t) \tag{1}$$

where L_t are leisure hours.[3] U is the life-cycle utility function, while *u(.)* corresponds to the utility in a specific period, assumed to be increasing and concave in its arguments. E_t is the mathematical expectations operator, conditional on the information set available in period t and β is the discount rate. This maximization is subject to the usual budget constraint:

$$A_{t+j+1} = R_t\left[A_{t+j} + (1-\tau_h)W_{t+j}N_{t+j} - P_{t+j}C_{t+j}\right] \tag{2}$$

where A_t is the individual's non-human wealth at the beginning of period t; R_t is the nominal interest factor, or gross interest rate, $R_t=1+r_t$, where r_t is the nominal interest rate;[4] W_t is the hourly wage and N_t is the number of hours an individual works in t; C_t is the

[3] Alternatively, as Zeldes (1989), we could have used a separable utility function depending on consumption and leisure.

[4] We generically refer to R_t as the interest rate.

individual real consumption in period t; and, P_t is the nominal price of a unit of C_t.[5] W_t as well as P_t are assumed to be exogenous. We include in expression (2) labour taxes, represented by τ_h.[6]

Under standard assumptions, we can define a value function V, that depends on A_{t+1} and represents the maximum utility expected from leisure by the individual in t+1. In our approach, we consider the possibility that an individual's employment status changes between t and t+1. As a result, we assume that the individual has a probability 1-π_t of being unemployed in period t. In this case, the value function becomes:

$$V(A_t) = \underset{L_t}{\mathrm{Max}}\{U(L_t) + \beta E_t[\pi_t V(A_{t+1}^N) + (1 - \pi_t)V(A_{t+1}^u)]\} \tag{3}$$

where $A_{t+1}^N = A_{t+1}$, as defined in expression (2), is the non-human wealth value at the beginning of t+1 if the individual is employed in period t, and A_{t+1}^u is the non-human wealth value at the beginning of t+1 if the individual is unemployed in t.[7]

From expression (3), applying the envelope theorem we obtain:

$$\frac{\partial V(A_t)}{\partial A_t} = \beta R_t E_t \pi_t \frac{\partial V(A_{t+1})}{\partial A_{t+1}^N} \frac{\partial A_{t+1}^N}{\partial A_t} + \beta R_t E_t (1 - \pi_t) \frac{\partial V(A_{t+1})}{\partial A_{t+1}^u} \frac{\partial A_{t+1}^u}{\partial A_t} \tag{4}$$

Assuming that the marginal utility of wealth is the same in the two states we are considering (being employed or unemployed), we obtain from equation (4) the following expression:

[5] Our analysis can be considered as part of a two-stage budgeting process (Stroz, 1957; Gorman, 1959). Additionally, we consider that consumption is a predetermined variable.

[6] Both the labour income tax and the social security contributions are included in τ_h.

[7] In this case, in the expression (2) $W_t N_t$ is substituted by S_t, the unemployment benefits, that are assumed to be exogenously given.

$$\left.\begin{array}{c}\frac{\partial V(A_{t+1})}{\partial A_{t+1}^{N}}=\frac{\partial V(A_{t+1})}{\partial A_{t+1}^{u}}=\frac{\partial V(A_{t+1})}{\partial A_{t+1}}\\ \frac{\partial A_{t+1}^{N}}{\partial A_t}=\frac{\partial A_{t+1}^{u}}{\partial A_t}=1\end{array}\right\}\Rightarrow\frac{\partial V(A_t)}{\partial A_t}=\beta R_t E_t\frac{\partial V(A_{t+1})}{\partial A_t} \tag{5}$$

The inclusion of a no-unitary probability of working, π_t, in the value function (5) does not impact the constancy of the marginal utility of wealth over time under these assumptions, and the optimization problem can be addressed as usual. Surprisingly, the marginal utility of wealth is unaffected by the likelihood of being unemployed, despite the fact that the first order condition for leisure will be affected by this probability, as shown in the following expression:

$$\frac{\partial U}{\partial L_t}=\beta R_t W_t E_t \pi_t \frac{\partial V(A_{t+1})}{\partial A_{t+1}} \tag{6}$$

The solution for the optimization problem is given by the intertemporal first-order condition for leisure:

$$E_t\beta\frac{\partial u/\partial L_{t+1}}{\partial u/\partial L_t}\frac{\pi_t}{\pi_{t+1}}\frac{(1-\tau_{h,t})W_t R_t}{(1-\tau_{h,t+1})W_{t+1}}=1 \tag{7}$$

Given the values of the exogenous variables, fulfilment of this equation indicates that individuals cannot raise their utility by modifying their leisure in an optimum. Note that uncertainty will affect the intratemporal decision if $\pi_t<1$ (i.e., that the individual considers uncertain to be working in period *t*). Furthermore, in the case of $\pi_t\neq\pi_{t+1}$, uncertainty will influence the intertemporal leisure equation. It should be noted that McCurdy's (1981 and 1983) model for consumption and leisure is a special case for this equation if $\pi_t=\pi_{t+1}=1$. As a result, anytime individuals experience labour uncertainty, as measured by the likelihood of being unemployed, they will re-assign their leisure/labour supply on a temporal basis (according to equation 7).[8]

We would like to make two considerations as regard our approach. On the one hand, we follow Prescott (2004) and Silva (2008) methodology, although our model is different in several aspects. First, they use a life cycle utility function, but their theoretical approach is static in nature, because the equilibrium relation they use to predict labour supply is obtained by combining the marginal rate of substitution between leisure and consumption, with the first-order condition of profit maximization that determines the marginal product of labour. As a result, their model excludes any intertemporal feature from the investigation from the start. Second, they ignore the impact of predicted changes in labour status and uncertainty on labour supply. Unlike them, we anticipate the behaviour of labour supply to tax changes using the intertemporal condition for leisure. Although the intratemporal condition they use provides a mechanism to modify individual labour supply through changing tax rates, this effect could be mitigated, or eliminated, by the effect of tax rates on consumption, given the relationship between both variables in the intratemporal equation. This, in our opinion, makes their methodology less appropriate than the intertemporal condition (7) for analysing the impact of tax changes on labour supply.

On the other hand, because our model may be used to represent individual or family decisions,[9] it could theoretically be compared to the unitary models developed by Oliver and Spadaro (2017) and Ayala and Paniagua (2019). Given that it is assumed that the

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[8] In an intertemporal model of consumption and leisure, both decisions will be affected by uncertainty through the intratemporal optimizing condition.

[9] In fact, Silva (2008) and Prescott (2004) using the same model consider it as a "*representative consumer*" or a "*stand-in-household*" decision model.

household acts as a single decision maker, this sort of model does not allow for the analysis of the transfer of resources among the household members. The alternative collective model, which considers households with two or more wage earners, requires the use of extremely specific information on each household member's spending and time use that is not available in our data.

An important issue arises from the analysis of equation (7): economic policies can be designed to change the labour tax rate to compensate for the impact of changes in uncertainty on leisure and labour. In theory, in a consumption-leisure model, this may be accomplished by changing the appropriate tax rates in either the intratemporal equation, as in Prescott (2004) and Silva (2008), or in the intertemporal equation of leisure (7). However, employing the intratemporal equation might be misleading as it mixes consumption and leisure, as well as prices and wages.

3. The empirical specification.

A utility function must be specified in order to derive empirical functions. We follow MaCurdy (1983) and Mankiw *et al.* (1985), who proposed a generalization of the CRRA utility function, which is frequently used in empirical consumption analysis, where we substitute consumption for leisure. We add a set of demographic variables (denoted as vector θ_t) because we aim at testing the model with individual data. The utility function we obtain is the following,

$$u(L_t) = \frac{L_t^{1-\phi} - 1}{1-\phi} e^{\lambda \theta t} \tag{8}$$

where ϕ and λ are parameters to be estimated (see Cutanda and Sanchis-Llopis, 2021). Once we introduce this utility function in the model, $1/\phi$ is the elasticity of intertemporal substitution for leisure.

We use utility function (8) to get empirically testable expressions. To begin, we take logs in the first order condition. Equation (7) is now rewritten by adding an individual subscript and applying the rational expectations assumption in the usual way, what yields the following tractable expression:

$$\Delta ln(L_{it+1}) = \frac{1}{\phi} ln\beta + \frac{1}{\phi} ln\left(\frac{1-\tau_{ih,t}}{1-\tau_{ih,t+1}} \frac{W_{it}R_t}{W_{it+1}}\right) + \frac{1}{\phi} \ln\left(\frac{\pi_t}{\pi_{t+1}}\right) + \frac{1}{\phi} \Delta\theta_{it+1} + \varepsilon_{ilt+1} \qquad (9)$$

where ε_{ilt+1} is an error term independent of all variables dated in t or before. It is worth emphasizing that the dependent variable in equation (9) is the growth rate of leisure, and we do not have the lagged level of leisure among the covariates (see Zeldes, 1989, and Runkle, 1991). In this regard, equation (9) shows the change in leisure in period t in response to a change in labour taxes in period t+1. As a result, the model predicts how people would react in terms of leisure if labour taxes are predicted to change. Given the current financial state of social security, this appears to be a viable option. It is worth noting that the likelihood of becoming unemployed is included as a time effect in the equation.[10] Furthermore, as the vector of demographic variables (θ_{it}) enters the specification in first differences, all time invariant demographic variables vanish.

[10] Alternatively, the likelihood of becoming unemployed may be time and individual dependant. This means that the likelihood of being unemployed would take the following form: $1-\pi_{it}=1-\pi_i\pi_t$. The ensuing equation (9) would have a time and an individual effect as a result of labour uncertainty. Therefore, in this situation, the model would allow to examine the impact of individual heterogeneity on uncertainty, as well as uncertainty related to specific labour activities. This would allow applying the Zeldes (1989) test to different groups of employees who are affected by varying levels of labour uncertainty.

The intertemporal elasticity of leisure, as determined by estimation of the equation (9), is the foundation of our empirical study. When employing panel data approaches, the constant term contains β in this equation, which should be treated as an individual fixed effect in estimation. Second, $\frac{1}{\phi}$ is the intertemporal elasticity of substitution for leisure. If employment uncertainty matter, and the model does not account for it, this parameter will be calculated with a bias. Our empirical analysis is based on our separability assumptions, as is customary in the literature. We also limit the estimation of equation (9) to working individuals, excluding households with an unemployed head. We further limit our sample to households with a head who is older than 23 years old in 1987.

The estimation of equation (9) provides the Frisch elasticity for labour supply. Frisch elasticities are the most important in an intertemporal context, whereas Hicksian and Marshallian elasticities are better suited to a static conceptual framework.[11] Hicks elasticity gives a lower bound for Frisch elasticity (see Chetty, 2012), and, like Marshall elasticity, may be derived from the static intratemporal equation, but Frisch elasticities require the Euler condition. In this line, Attanasio *et al.* (2018) use an estimation of the intratemporal equation between consumption and leisure to obtain the Frisch elasticity for labour supply. In an intertemporal setting, however, Mankiw *et al.* (1985) established the distinction between short and long run elasticities. Our approach is similar to that of the previous study. As a result, we could obtain all of these elasticities by either directly estimating them or retrieving them analytically from the estimates produced. Keane (2011)

[11] These elasticities have been studied extensively in research looking at the impact of tax increases on labour supply, both in a static and dynamic context. For the first situation, see Eklöf and Sacklén (2000) and Bloomquist *et al.* (2001), while for the second case, see Blundell and Walker (1986), Ziliak and Kniesner (2005), and Aaronson and French (2009).

gives a comprehensive and up-to-date review of the literature findings for these various elasticities.[12]

The estimation of the reaction of labour supply to income tax changes has been analysed using different approaches in Spain. Carrasco and Ruiz-Castillo (2006), that constitutes one of the first studies, use a simplified application of the collective approach to household behaviour, under the assumption that household decisions are Pareto efficient. There are a second group of works based on behavioural microsimulations that estimate the labour supply responses in a static setting. Estimation of the labour supply, through the estimation of the utility function parameters, allows obtaining the wage elasticity for the intensive and the extensive margins. Once these estimates are available, it is possible simulate labour supply responses to any tax change. Labeaga et al. (2008), Oliver and Spadaro (2017) and Ayala and Paniagua (2019) are different examples applying this methodology. Finally, Díaz-Caro and Onrubia (2018) use a different approach to analyse how taxpayers responded to the introduction of the dual personal income tax model in 2007, using microdata on personal income tax return. In this paper the elasticity of taxable income with respect to the marginal net tax rate is estimated for different groups of taxpayers depending on different characteristics.

Our simulation methodology differs from these approaches in two aspects: first, as we stated above, we analyse the intertemporal behaviour of labour supply in a dynamic framework, what allows analysing individual's labour reaction to anticipated future tax changes; and second, we only analyse this reaction at the intensive margin. We consider that analysing individual's anticipated reactions in this field is more realistic than the static

[12] In Table 6 (page 1042) there is an exhaustive compendium for the values obtained previously in the literature, for these elasticities.

approaches, as tax policies are usually approved and implemented with some delay, allowing individuals to plan and anticipate their reactions. Further, the reaction of labour supply to tax changes is not necessarily going to happen in only one period, as it is usually considered in static analysis, but it might occur in several periods (before, during and after the tax change is implemented). In this sense, the announcement of a future increase in the labour tax, for example in period t+1, will result in a rise in the labour supply before the increase takes effect, in period t, as the tax in t are lower than in t+1, and a decline after. However, it is difficult to predict the overall net effect unless one is willing to making further assumptions.[13] Thus, focusing only in the one period (the same one of the tax change) might not fully capture the overall effect.

The estimation of specification (9) raises some econometric challenges. To begin with, the individual fixed effect might be correlated with the regressors. Second, income might suffer from measurement error. Furthermore, the standard method of calculating wages, when this variable is not present in the data set, is dividing income by hours worked, that could be another source of measurement error (see Altonji, 1986). Although the averaging process we use to create the cohorts could alleviate this problem, we adopt an instrumental variables estimator, i.e. the two-step generalized method of moments (see Griliches and Hausman, 1986). To overcome this problem, we avoid utilizing current values of income, spending, interest rates, hours, wages, or any other variable directly tied to a household's income as instruments in the estimation of equation (9), and we treat demographic factors as exogenous. The Hansen's test of test of overidentifying restrictions will be used to assess the goodness of fit.

[13] The labour supply static models only considered the effect on labour supply in the period where the tax is increased.

In the following figure we represent the simulation exercise we empirically perform.

[Figure 1 around here]

4. The data.

Our empirical research is based on a combination of two Spanish datasets: the Family Expenditure and Income Survey (*Encuesta Continua de Presupuestos Familiares*, ECPF) and the Labour Survey (*Encuesta de Población Activa*, EPA).[14] We need to combine these two datasets because we aim at estimating the intertemporal condition for leisure from an optimization program with Spanish cohort panel data using information on individual labour supply and income (in order to get wages). Furthermore, our analysis is based on the use of these estimations to investigate the effects of tax incentives on labour supply. The ECPF is the principal survey in Spain that collects panel data on income and consumption up to 2005. This data set, however, does not include information on hours worked.[15] Although these data include information on household income, they do not provide specific information on which household members earn that income.[16] As regards

[14] With data from 2002 onwards, the Spanish Survey of Household Finances (Bank of Spain), Encuesta Financiera de las Familias, EFF, offers information on consumption, income, hours worked, and wealth. Prior to 2002, it is only possible to obtain continuous-time microeconomic information on wages by combining the two surveys.

[15] This is true only for the ECPF (base 1985) and not for the ECPF (base 1997), technically speaking. Despite the fact that the quality of consumption data in both ECPF bases is comparable, there are reasons to have doubts on the information on income in the ECPF (base 1997). This is so as only 13225 observations (out of 183379 observations, 8% of the total) report their exact value of income during the entire period (1998.1-2005.4). The rest of observations report just income intervals.

[16] While it is possible to determine an individual's income using adequate sample selection, we must contend with the loss of observations. The most obvious example would be a sample of households with only one

labour supply, the EPA does not include information on individual consumption, income, or wages.[17]

We constructed the same pseudo-panel using the age of the household head in both surveys to incorporate the information available from both statistical sources (see Browning et al., 1985). We merge both data sets once we get the pseudo-panel in the income (ECPF) and labour (EPA) surveys.[18] These two surveys are conducted on a quarterly basis. We have 41 points in data because the first period is the first quarter of 1987 and the last one is the first quarter of 1997. The large time span available for estimating the Euler equation of leisure, guarantees that the intertemporal elasticity of substitution can be reliably computed (see Attanasio and Low, 2004). The pseudo-panel we construct is made up of eight households with five-year bands for the head of the household, with the minimum and maximum ages of 18 and 57 years old, respectively. However, we will only consider six of these cohorts in the empirical study, based on the minimum and maximum ages of 23 and 52, respectively, in 1987, (34 and 63, respectively in 1997).[19]

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source of income. This group has a mean size of 33 persons across the study period. As in Oliver and Spadaro (2017), this problem prevents using the sample of single households to carry out the analysis.

[17] The EPA does not have any information on labour market flows. The EPA is a survey of the stocks of the Spanish labour market, at least in the public version. Despite this, the INE has conducted a survey on labour force flows since 1996, a year before our sample period final year.

[18] Lugilde *et al.* (2018) provide a good example of the unavailability of Spanish data for a joint analysis of household consumption and income and labour supply during the time period under consideration.

[19] We have applied all the standard filters in this kind of studies. In this respect, both in the ECPF and the EPA, we have excluded households with no data on expenses, income, hours worked, or any other relevant characteristics. In addition, as is customary, all households with income in the first and final percentiles of the distribution have been excluded from the ECPF.

We calculate four different samples to carry out the empirical exercises proposed. In the first, we have a representative sample of workers (households where the head of the household is a non-self-employed male and his wife or any other household member are not working).[20] In the second and third ones, we build a sample of workers who have either a permanent or temporary job. Finally, we narrow the sample of permanent workers by focusing only on those who work in the public sector, as these individuals are the least affected by labour uncertainty.[21] We have devised a process to estimate the wages of these sorts of workers based on the information available, which includes the labour average income perceived and hours worked for the sample of all workers, as well as the average hours worked for the samples of our three types of workers.

This procedure to estimate wages is explained as follows. Assuming that Y_t and L_t are, respectively, the average labour income and the average hours worked for the sample of all workers, and L_{Pt} and L_{Ft} are, respectively, the average hours worked for the sample of workers with permanent and fixed-term contracts, then we can write,

$$\frac{Y_t}{L_t} = \frac{W_{Pt}L_{Pt}+W_{Ft}L_{Ft}}{L_{Pt}+L_{Ft}} = W_t \tag{10}$$

where W_{Pt}, W_{Ft} and W_t are the average hourly wage of, respectively, undefined-time contract workers, fixed-time contract workers and all workers.

From expression (10), we can obtain the wage of every subsample of workers:

$$W_{Pt} = W_t + (W_t - W_{Ft})\frac{L_{Ft}}{L_{Pt}} = W_t\left(1 + \frac{W_t - W_{Ft}}{W_t}\frac{L_{Ft}}{L_{Pt}}\right) \tag{11}$$

[20] Evidence for the total sample comes from Cutanda and Sanchis-Llopis (2021).

[21] For evidence on temporary employment in Spain, see Sánchez and Toharia (2000), Dolado *et al.* (2002), Díaz and Sánchez (2004) and Rodríguez (2012).

$$W_{Ft} = \cdots = W_t \left(1 + \frac{W_t - W_{Pt}}{W_t} \frac{L_{Pt}}{L_{Ft}}\right) \quad (12)$$

According to these expressions, the average wage for each group in each period is determined by the average wage for the total sample of workers, the ratio of hours worked in each group of workers, and the difference between the average wage for the total sample and the wage of the complementary group (i.e., the other group).[22] The excess wage values are assumed to be constant over time. Given that we can calculate the excess wage value using an external source on the Spanish wage structure, we can estimate both average wages.[23]

Given that the definition and scope of the household variables are standard in the ECPF, we take the variables directly from this survey. To determine wages in the overall sample, we divide employees' income from the ECPF by the hours worked by employees in the EPA, as recommended in the literature. Using this approach, we may have a measurement error problem (see Keane, 2011), which we must address in estimation of the model. Given the lack of information on the type of contract (either temporary or permanent) in the ECPF, but not in the EPA, we use the same approach explained above to estimate wages for the two groups of workers (permanent and temporary). This procedure is in accordance with the evidence available for Spain in terms of relative wage

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[22] This approach needs the following: the ratio between all inferred wages must be stable, and they must all grow at the same rate. These assumptions may appear to be restrictive. However, we believe it is not so limited in the long run, when the wage structure in the economy is expected to remain relatively stable. It is also worth to consider that Spain was an outlier in the broader trend of rising wage inequality that many economies faced during this time (see Carrasco, 2007, or Izquierdo and Lacuesta, 2007). As a result, the premise of steady relative wages in Spain gains some support.

[23] To achieve this goal, we use the Wage Structure Survey (*Encuesta de Estructura Salarial*, EES), the most extensive survey of Spanish wages. It includes wages for both fixed-time and undefined-time contracts. We use data from 1995 because it is the only year that falls within our analysis period.

stability during these years (see Carrasco, 2007, Izquierdo and Lacuesta, 2007, or Amuedo-Dorantes and Serrano-Padial, 2007). For each of the age cells in our pseudo-panel, we utilize it to estimate the wages of temporary and permanent workers.[24]

Given the statistical sources available in Spain and the time period we analyse, we are unable to examine female labour supply because doing so would significantly reduce our sample size,[25] as there exists a reduced number of households with a female head in the period study.[26] Furthermore, because the ECPF only gathers household income, our approach is comparable to Blundell and Walker (1986) in that it considers household, not individual, labour supply. However, due to the limited sample sizes available in the ECPF, we only include households in which the head is a non-self-employed male and his wife or any other household member is not working.[27] We have also eliminated any families where the head states that he is unemployed or retired. As a result of this selection, we feel confident in examining the Spanish male labour supply,[28] although our framework could

[24] In this vein, De la Rica (2004) estimates the wage gap between fixed-term and permanent contracts to be 0.43, based on data from the first wave of the Wage Structure Survey, which corresponds to 1995, though she concludes that only 0.09 of it remains unexplained once other factors are considered.

[25] In addition to sampling problems, pseudo-panel data techniques are not suitable to analyse the participation decision, as it would require: probabilistic models (probit, tobit), individual data (not averaged data), and being able to follow individuals across time.

[26] The average size of the sample of single households with a woman as the head (with labour income) in the period we consider is 74. In the period we study, the average size of our selected sample of families whose head is a married labour income earner during the period we analyse is 704.

[27] Also, and for similar reasons, Lugilde *et al.* (2018) restrict their sample to households where the reference person is an employee. We are aware, however, of the importance of the household perspective in labour decisions. See Duguet and Simonnet (2007), Apps and Rees (2010), or Blundell *et al.* (1994, 2016a, 2016b and 2018).

[28] We acknowledge that this sample of households might be more inelastic than other types of households, like households with more than one labour income earner. Therefore, the results we obtain might be limited due to this selection of households. We thank an anonymous referee for pointing to this issue. However, we would like to point that this selection is aimed at reducing the measurement error in the calculation of wages

be considered as a household decision model, which seems reasonable considering the minimal female participation in the labour market during the period under consideration.[29]

In Table 1 we report the average number of persons in the two pseudo-panels (one from the ECPF and the other from the EPA) constructed for our analysis. These numbers are consistent with previous studies, particularly in the reduced pseudo-panel. It is worth noting that, due to the large number of periods available, both the youngest and oldest cohorts are shrinking over time. Finally, given the EPA initial higher size, the average size of the EPA cohorts is substantially larger than that of the ECPF cohorts.

[Table 1 about here]

The variables we utilize in estimation are described in what follows (see also Table A.1 in the Appendix). The nominal wage for the entire sample was calculated by dividing the head of household's quarterly labour income in the ECPF by the effective hours declared in the EPA. We followed the approach stated above for the wages of the remaining samples. The quarterly leisure hours were calculated by subtracting the effective hours worked from the total number of available hours. The number of available hours is determined by multiplying the number of days in the quarter by 16 hours. In terms of the price index, we use the expenditure categories analysed to calculate a Stone price index for each cohort in our sample. We utilize a nominal interest rate for the Spanish bank

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that can emerge when using households with more than one labour income earner. Finally, Cutanda and Sanchis-Llopis (2022), using a broader sample of households drawn from the Spanish *Encuesta Financiera de las Familias*, for the period 2002-2017 obtain similar estimated values for the elasticity of intertemporal substitution of leisure.

[29] According to the INE, the female participation rate was 30.02% in 1987.2 (the previous quarter is not available) and 38.53% in 1997.1, when the male rates were, respectively, 70.15 and 64.93%. In relation to this, Martín-Román et al. (2020) found that there are substantial differences in the cyclical sensitivity of male and female labour participation rates in the Spanish provinces.

deposits, similar to that employed by Cutanda *et al.* (2020). The nominal interest rate does not differ between cohorts, but the real interest rate does since the cohort price index varies.

5. Empirical results.

To carry out our labour tax simulations, we need first to calculate the elasticity of intertemporal substitution for leisure. This parameter is obtained by estimating equation (9). Table 2 shows the estimated elasticity of intertemporal substitution for leisure obtained in three specifications,[30] and for the four samples we analyse: a pseudo-panel of male wage earners (total sample), a subsample of permanent contract male workers, a subsample of fixed-term contract male workers, and the subsample of permanent contract male workers in the public sector.

[Table 2 about here]

The estimates for intertemporal elasticity of leisure with the various specifications in each sample are very similar, albeit they differ when compared to other samples estimations. These figures come from Cutanda and Sanchis-Llopis (2021), and imply that the elasticity of intertemporal substitution for leisure is less than 0.5. As a result, whereas the predicted elasticity parameters for the overall sample range from 0.25 to 0.3, we get a value somewhat higher than 0.3 for the permanent workers sample.[31] Finally, we obtain a

[30] These specifications differ in their covariates. The first specification includes the age of the head of the household, its square, the number of members, and the number of adults in the household. The second specification adds three education dummies to the previous one. And the third specification includes a dummy variable for the head of the household's professional status.

[31] These results are similar to the elasticities estimated for male labour supply at the intensive margin, reported by Oliver and Spadaro (2017). These elasticities are 0.212 and 0.016, for the unconditional and conditional elasticities, respectively.

parameter estimate of less than 0.15 for the sample of fixed-term contract workers. These findings suggest that different groups of employees have variable degrees of intertemporal substitution for leisure. Indeed, the differences across groups show that there may be a composition effect when estimating this parameter using the complete sample as compared with distinct subsamples of workers.

We may therefore conclude from our estimation results that the degree of intertemporal substitution of leisure for the Spanish economy is significantly lower than the value predicted by the parameters commonly used in macro models, such as those used by Prescott (2004) and Silva (2008) in their simulations.[32] Furthermore, our findings suggest that there is heterogeneity within the sample of male employees, as we obtain different estimates in subsamples with variable duration/uncertainty of the labour contract, a conclusion that macro simulations are unable to get. In this regard, we find that the sample of permanent workers has the highest intertemporal elasticity estimate, whereas the sample of fixed-term contract workers has the lowest value. Our findings suggest that labour duration uncertainty influences intertemporal leisure substitution, so that the higher the uncertainty, π_t, the lower the intertemporal substitution of leisure/labour.

We implement the simulation procedure using these intertemporal elasticities and the three samples mentioned above. To do so, we experiment with various tax modifications to see how effective they are in terms of hours worked.[33] The simulation process will allow measuring changes in working hours in period t in response to changes

[32] One of the reasons why aggregate data estimates of the intertemporal elasticity of leisure are higher than individual data estimates is that the first captures both the intensive and the extensive margins in labour supply.

[33] Given that the three predicted elasticities in the specifications studied are relatively similar, we use an average elasticity in the simulating exercises.

in the tax rate between t and t+1, according to the estimated intertemporal elasticity, and provided that in our life cycle model, individuals may react today to tax changes announced for the future. The average weekly hours worked for each studied sample of workers, obtained from the EPA, would be used to transform these changes in hours into equivalent percentage points of the unemployment rate (for the considered sample). Note that, in this simulation process, we use these average weekly hours and the labour market statistics (also provided by the EPA) for the population that corresponds to each sample analysed, in order to derive national aggregates from the outcomes of the simulations. In particular, we use the fourth quarter of 2021, which is the last available wave in the EPA. In the simulations, we adopt a 21.1 percent labour tax rate as the average.[34]

We present a thorough example of our simulation exercise in Table 3. For the total samples of male and female workers, we consider a one-point rise in the labour tax rate, from 21.1 percent to 22.1 percent in the first quarter of 2022. This tax increase results in a 1.003 point rise in leisure growth between periods t and t+1, based on the average estimated elasticity for the first group. This change translates to an increase of 1405954 hours worked by male wage earners in the fourth quarter of 2021, considering the total aggregate hours worked in Spain at the time, according to the EPA. As a result, based on the weekly average hours worked by male wage workers in the EPA, this equates to an increase of 38625 in the number of male wage earners (assuming that the increase in hours is met by contracting new employees). Finally, based on the number of jobless and active male wage workers in the fourth quarter of 2021 (in the EPA), the unemployment rate would fall by 0.315 percent, from 12.109 percent to 11.794 percent.

[34] This is the average income tax rate in Spain in 2019, including social security contributions, for single workers earning the average wage in 2019 (See datosmacro.com).

[Table 3 about here]

It is important noting that our model predicts an increase in hours worked in period *t* in expectation of a future increase in income taxes (in period *t*+1) in order to appropriately evaluate the results shown above. In a life cycle setting, workers consider that such announcement would make less profitable to work in the future, provided that the expected (net of taxes) wage in *t*+1 would decrease, as compared to its current net value in *t*. This will consequently raise (decrease) the opportunity cost of leisure (working) in *t*. Therefore, for a given intertemporal individual allocation of leisure (working) time, the announcement in *t* of an increase of income tax rates in *t*+1 would make the individuals to reduce (increase) their leisure (working) time in *t*, as income taxes are lower in *t* than in *t*+1. Correspondingly, the individuals will optimally reduce (increase) their working (leisure) time in period *t*+1, in which the change of the opportunity cost of leisure (working) time is the opposite than in period *t*. Note that static models only consider the effects in period *t*+1, ignoring the effects produced by the announcement in period *t.* The effect of income tax changes on labour supply should therefore be measured in all the periods that individuals consider in their behaviour optimization processes, not only in the period in which the tax change is implemented, in accordance with the intertemporal substitution of leisure model.

Next, we apply this simulation approach to the female wage earners group (also reported in Table 3). For this simulation, we use the elasticity of intertemporal substitution for leisure estimated in the male wage workers sample.[35] In this scenario, the resulting

[35] We adopt this assumption because, for the period 1987-1997, both the EPA and the ECPF provide relatively limited samples for female heads of households. This makes it impossible to build a reliable pseudo-panel for women. In any case, Oliver and Spadaro (2017) find that the Spanish female elasticity at

increase of 1456970 hours worked by women is equivalent to an increase of 45817 new female wage earners, implying a 0.416 percent reduction in the female unemployment rate, from 15.454 to 15.038 percent. Using the results presented for both men and women, the overall unemployment rate would drop from 13.327 percent to 12.967 percent.[36]

From the aforementioned findings on labour supply, it is possible to evaluate the impact of a 1% income tax rate increase in period t+1 that was announced in period t on tax revenues. This will enable an evaluation of the policy's ability to balance the social security system deficit in Spain. To do this, we use the annual average gross wage and the increased tax rate to calculate the average annual increase in each individual tax burden. To obtain the aggregate impact we account for the number of wage earners in the specified period. In this exercise, wages are taken from the last available wave of the Wage Survey (Encuesta de Estructura Salarial, ESS), that corresponds to 2018. Applying this procedure to the increase in equivalent male workers in period t, 2018 in our case, as a result of the tax increase announcement in t+1, 2019, we obtain an increase in tax revenue of about 65 € millions, that is due to the increase in hours worked at the previous tax rate. However, this is not the overall effect as we have to compute what occurs in t+1, when the increase in taxes is effective. A possible, but not fully realistic situation, would imply assuming that the number of worked hours in 2019 are the same as those in 2018, prior to the announcement. In this case, the tax revenues increase from male wage earners would amount to 2280 € millions, that is due to the increase in the tax rate over the same number

the extensive margin amounts to 0.26. This value is quite close to the estimates we obtain for males at the intensive margin.

[36] When we use a value of 3 for the elasticity, which is consistent with the parameters used in Prescott (2004), the unemployment rate for the males and total samples changes by -0.959 percent and -1.106 percent, respectively.

of worked hours. However, according to our model, individuals would react in 2019 to the increase in taxes. So, individuals will reduce hours worked in 2019. We can consider as an alternative that individuals reduce the worked hours in 2019 exactly in the same amount that they increased them in 2018, although the reduction could be even greater than that. In this case, the increase in revenues would have been 2270 € millions.[37] In summary, the estimated increase in total tax revenues from male wage earners (after a 1% tax income rise) would be clearly insufficient to overcome the deficit of Spanish social security (that amounted to 17310 € millions in 2018 and 15860 in 2019).[38]

Now we turn to our simulations for the samples of men earners with permanent and fixed-term jobs, as well as with a permanent contract in the public sector, we replicate our simulation procedure. Table 4 summarizes the outcomes of these simulations. We estimate their equivalent worked hours using the percentage of each group in the total number of male wage earners from the relevant aggregates in the fourth quarter of 2021, provided that the EPA does not distinguish the total hours worked by wage earners for these two groups of workers.

The increase in hours worked induced by the tax change amounts to 1445661 for male permanent wage earners, implying a 0.323 percent decrease in their unemployment rate. If we use the same simulation procedure for female earners, the change in female hours worked is 1360460, resulting in a 0.389 percent reduction in the female

[37] Similar calculations for female wage earners provide an increase in tax revenues between 1765 and 1756 € millions, with the same considerations.

[38] It is important to note that these calculations would overestimate the increase in tax revenues, given that we do not consider the reactions to the tax increase in the extensive margin. Further, in an intertemporal setting it is feasible that individuals allocate their reactions in worked hours in several periods.

unemployment rate, implying that the overall unemployment rate, which includes men and women, falls by 0.354 percent (from 13.327 percent to 12.973 percent).

[Table 4 about here]

For the sample of fixed-term contract male employees, for whom we calculated an intertemporal elasticity of substitution below 0.15, the same increase in the tax rate would result in a 174583 increase in the hours worked. This rise is equivalent to a 0.039 percent decrease in their unemployment rate (0.062 percent for the female fixed-term contract sample and 0.050 percent for the general unemployment rate, considering both men and women).

Furthermore, given that an individual's labour supply changes throughout his or her life cycle, the effect of tax changes on leisure/labour supply would depend on their age. To test this hypothesis, we will expand our simulation to include three broad age cohorts from the overall male wage earners population. As a result, our final simulation exercise entails determining if there are disparities in the reaction of leisure/labour supply to income tax increases based on the taxpayers' age. To conduct this study, we separate the male wage earners sample into three age groups: young (18 to 29 years old), mature (30 to 54 years old), and old (55 to 70 years old). The definition of cohort age bands is contingent on the requirement to reduce the number of observations as little as possible in order to avoid measurement error problems in estimation. [39] It is worth noting that the EPA gives less information on age band cohorts, as compared to the public aggregate data that we use

[39] We just provide the average of the estimated elasticity for the three specifications in this case. These results are, however, available upon request.

to generate our simulations, which implied the need to make certain assumptions in our simulation approach.[40]

We calculate the weekly hours worked for each cohort using the EPA aggregate data. Once we have identified this variable, we apply the average of weekly hours worked for the complete sample of wage earners to each of our age band cohorts. After that, we implement the simulation procedure to each cohort. As shown in Table 5, increasing the tax rate by 1% reduces unemployment by 0.194, 0.252, and 0.089 percent for young, mature, and old male wage earners, respectively. Using these numbers, the unemployment rate for men (of any age) would decrease by 0.211 percent.

[Table 5 about here]

The use of the men's estimated intertemporal elasticity of substitution for female wage earners results in bigger disparities in the reaction of each cohort of women's labour supply to the tax change. As a result, the unemployment rates for young, mature, and old female wage workers are reduced by 0.253, 0.438, and 0.055 percent, respectively. Surprisingly, aggregating the increases in hours worked by our three female cohorts results in a 0.480 percent drop in the unemployment rate for women of all ages, which is more than double the result we observed for the same tax reform in the simulation with the male cohorts.[41]

Finally, in Table 6, we compare the results of a 1% reduction in the labour tax rate to the results of a 1% rise in the tax rate, and successive increases in the tax rate (2 and 3

[40] For many characteristics, the EPA gives multiple age-band intervals. The band limits in some cases do not exactly match the ones used to establish the age cohorts. In these circumstances, we choose the age band cohorts that are most similar to our pseudo-panel.

[41] These results are available to the interested reader upon request.

percent). As can be seen, depending on the sign of the tax adjustment, the labour supply/leisure reacts as expected, even though the effects are comparable in absolute value. Furthermore, subsequent changes in the tax rate induce equivalent changes in the number of weekly hours worked and the unemployment rate. However, given the magnitude of these effects, our findings suggest that, contrary to Prescott (2004) and Silva (2008), raising the labour tax rate may not be a viable policy option for addressing the social security system budgeting challenge in Spain, as it would need an unfeasible tax increase. Finally, we would like to remark that our model does not consider the decision to participate in the labour market. It appears reasonable to assume that if tax pressure rises over a certain level, some people, particularly women, will choose not to participate in the labour market. As shown in Martín-Román (2022), labour supply decisions (i.e., the extensive margin) can be very sensitive to fiscal incentives in Spain.

[Table 6 about here]

6. Conclusions.

The relation between labour supply and income taxes has attracted considerable study in recent years. This is mostly due to two factors: rising challenges in funding social security systems, and the limited outcomes obtained in the past through fiscal policies designed to promote labour demand.

Our research is framed in this literature, and it tries to determine the impact of changes in income taxes and social security contributions on the labour supply in Spain. Within this literature, our research differs from earlier studies in that we employ estimates of the elasticity of intertemporal substitution for leisure estimated from individual data. This is significant because, on the one hand, there is not a consensus in the literature on the appropriate value for the elasticity of intertemporal substitution for leisure (either the low value estimated using microeconomic data or the large value obtained with aggregate data). On the other hand, considering a high value for the elasticity of intertemporal substitution for leisure has provided support to the argument that governments may not need to rely on taxes to fund social security (Prescott, 2004).

Our simulations are based on the intertemporal first-order condition obtained via an individual optimization program, whereas prior works have been based on the intratemporal first-order condition. Finally, we derive our estimates of the elasticity of intertemporal substitution for leisure using a pseudo-panel constructed by merging data from the EPA and the ECPF, ensuring that we have data for all of the variables we need for the period under consideration. It is worth mentioning that there was no reliable statistical source for income, consumption, or labour supply in Spain prior to 2002. Thus, our results are limited by the sample selection criterium used to obtain reliable income data (as our sample is composed by households in which the head is a non-self-employed male and his wife or any other household member is not working). However, this selection is meant to improve the accuracy of the calculated wage.

We may conclude from our simulation results that changes in income taxes and social security contributions have an impact on the labour supply in Spain (that we measure in terms of equivalent changes in the unemployment rate). Second, we believe that these changes are minor, with all of them accounting for less than 1% of the unemployment rate for the group studied, even when tax rates are increased by 3%. Third, our findings suggest that women's labour supply is more responsive to tax changes than men's, however this conclusion is contingent on the fact that we use a value for the women's elasticity of intertemporal substitution of leisure computed in the sample of males.

Fourth, our findings show that the highest response in terms of labour supply corresponds to permanent contract workers, which is consistent with the variations in the available estimated elasticities for different samples of workers. Finally, our findings reveal that the labour supply response varies by age group. The mature cohort had the highest response, while the elderly cohort had the lowest response. Given the uneven distribution of various sorts of contracts across age, this conclusion is consistent with the variance in labour supply reaction to tax changes based on the term of the labour contract. As a caveat to our simulations, we should point out that our estimates do not consider changes in labour market participation as a result of tax changes.

The differences between our micro-simulation results and those obtained earlier with macro-simulations by Prescott (2004) and Silva (2008) emphasize the limits faced by these types of exercises: first, even if the calibrated values for the parameters often used in macro simulations are congruent with known aggregate evidence, they may differ from the consensus values based on the outcomes of empirical studies using micro data. This is basically explained by the different features of aggregate data compared to individual data, but it is more than anecdotal, given that these macro models are supposed to be soundly micro economically founded. Finally, by their very nature, macro simulations are unable to delve into the wide range of economic behaviours that simultaneously occur in any macro aggregate, in comparison with the empirical analysis with individual data, though this problem may be mitigated as a result of technological and scientific progress in computing and data management.

In general, our findings lead us to conclude that, while there is potential for utilising tax incentives to increase labour supply, the magnitude of the impact will not be sufficient to solve the Spanish social security system current financial challenges. The small estimates of the elasticity of intertemporal substitution of leisure obtained using microdata are substantially lower than those used in macro research, imply that we can deduce that the social security budget difficulties will not be solved solely by raising income tax rates.

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Figure 1. Labour supply decisions, taxes and Social Security deficit.

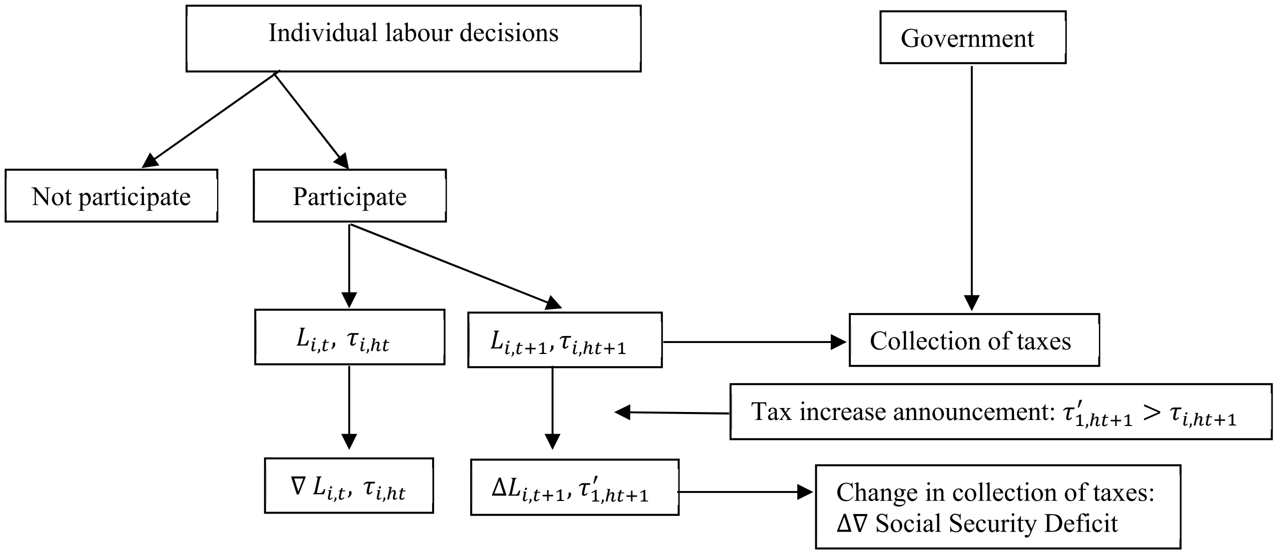

Table 1. Average number of individuals within each age cohort.

N. of Cohort	Age of head of house. in 1987	Age of head of house. in 1997	ECPF	EPA
1	18-22	29-33	41	622
2	23-27	34-38	94	1373
3	28-32	39-43	118	1876
4	33-37	44-48	126	1988
5	38-42	49-53	116	2133
6	43-47	54-58	82	1868
7	48-52	59-63	58	1622
8	53-57	64-68	47	1288
Mean 1-8			85	1596
Mean 2-7			99	1810

Notes:

a. In the ECPF we select only households whose head is a man and has income as employee (i.e., we discard all households whose head declares to be self-employed, unemployed or pensioner), and whose wife has not income as employee or as self-employed. In the EPA we select male households whose head declares to be an employee and whose wife declares not to be.

b. Our estimation sample is composed by cohorts 2 to 7, that are framed in the table.

Table 2. Estimates for the elasticity of intertemporal substitution for different samples.

	EISL		
	(1)	**(2)**	**(3)**
Total Sample	0.247***	0.284***	0.256***
	(0.061)	(0.041)	(0.046)
Hansen's J (*p value*)	0.573	0.542	0.630
Permanent contract workers	0.325***	0.362***	0.365***
	(0.160)	(0.181)	(0.194)
Hansen's J (*p value*)	0.777	0.823	0.796
Fixed-term contract workers	0.138***	0.140***	0.144***
	(0.026)	(0.026)	(0.026)
Hansen's J (*p value*)	0.714	0.665	0.895
Permanent workers public sector	0.258***	0.251***	0.248***
	(0.126)	(0.120)	(0.125)
Hansen's J (*p value*)	0.843	0.776	0.775

Notes:

a. *** mean statistically significant at the 1% level.
b. Each column presents the estimate for the elasticity of intertemporal substitution in three specifications: (1) we include age of the head of the household and its square, number of members and number of adults of the household; (2) we extend specification (1) with three educational dummies (illiterate and primary education, high school and college); and, (3) we expand specification (2) with a dummy for the professional category of the head of the household.
c. For more information, see Cutanda and Sanchis-Llopis (2021).

Table 3. Effects of an increase of labour income tax, total sample (men and women).

	$\left(\frac{1-\tau_{ih,t}}{1-\tau_{ih,t+1}}\right)^{eisl}$	Weekly hours worked	Change hours worked	Change number workers	Change unem. rate	Unem. rate
Men	1.003	36.4	14904954	38625	-0.315%	12.109%
Women	1.003	31.8	1456970	45817	-0.416%	15.454%

Notes:

a. EISL is the average of the estimated elasticities for the total sample of male or female workers.
b. Information required for the 4th quarter of 2021 is obtained from the EPA.

Table 4. Effects of an increase of labour income tax on different subsamples of workers (men and women).

	$\left(\frac{1-\tau_{ih,t}}{1-\tau_{ih,t+1}}\right)^{eisl}$	Weekly hours worked	Change hours worked	Change number workers	Change unem. rate	Unem. Rate
Men						
Permanent	1.004	36.4	1445661	39716	-0.323%	12.117%
Fixed-term contract	1.002	36.4	174583	4796	-0.039%	11.833%
Permanent Public	1.003	33.6	181977	5416	-0.044%	11.838%
Women						
Permanent	1.004	33.6	1360460	42782	-0.389%	15.456%
Fixed-term contract	1.002	33.6	217342	6835	-0.062%	15.100%
Permanent Public	1.003	33.1	194080	5863	-0.053%	15.091%

Notes:

a. EISL is the average of the estimated elasticities for the different samples of male or female workers.
b. Information required for the 4th quarter of 2021 is obtained from the EPA.

Table 5. Effects of an increase in labour income tax on different age cohorts (male workers sample).

Cohort	$\left(\frac{1-\tau_{ih,t}}{1-\tau_{ih,t+1}}\right)^{eisl}$	**Weekly hours worked**	**Change hours worked**	**Change number workers**	**Change unem. rate**	**Unem. rate**
Young (18-29)	1.002	36.4	132612	3643	-0.194%	24.218%
Mature (30-54)	1.003	36.4	726433	19957	-0.252%	9.606%
Old (55-70)	1.001	36.4	80199	2203	-0.089%	10.421%

Notes:

a. EISL is the average of the estimated elasticities for the different samples of male workers.

b. Information required for the 4th quarter of 2021 is obtained from the EPA.

Table 6. Comparison of 1% decrease/increase in labour tax (male workers sample).

	Final tax rate in 1st quarter of 2022			
	20.1(-1)	22.1(+1)	23.1(+2)	24.1(+3)
Increase weekly worked hours	-1383638	1405954	2834878	4287453
Equivalent increase in workers	-38012	38625	77881	117787
Effect on unemployment rate	0.310%	-0.315%	-0.634%	-0.959%
Final men unemployment rate	11.484%	12.109%	12.498%	12.753%

Notes:

a. The sample used for this table is the same than in Table 3.

b. The initial unemployment rate is 11.79%, as in Table 3.

Appendix.

Table A.1. Variables used in the analysis.

C_{it}	Non-durable consumption.
N_{it}	Worked hours.
L_{it}	Leisure hours.
W_{it}	Wage per hour.
$W_{it}N_{it}$	Labour income.
P_{it}	Nominal price of a unit of C_{it}.
$R_{t=}1+r_t$	Nominal interest rate.
θ_{it}	This a vector of demographic variables. In particular, we include the number of members of the household, the number of adults of the household (individuals14 years old or older), and a set of educational dummies (Illiterate and/or primary education; high school; and, college).